

**CLAIMS**

What is claimed:

- 1        1.        A method for dynamically controlling cooling resources in a data center  
2        comprising:  
3                determining a workload within the data center;  
4                determining an amount of heat being generated as a function of the workload; and  
5                activating each of a plurality of different types of cooling resources within the  
6        data center in an optimal fashion based on the heat being generated.
- 1        2.        The method of claim 1 wherein the optimal fashion is based on a cost associated  
2        with the activation of each of the plurality of different cooling resources.
- 1        3.        The method of claim 1 wherein the method further comprises:  
2                deactivating one or more of the activated plurality of different types of cooling  
3        resources within the data center based on a reduction in the amount of power being  
4        consumed by the workload.
- 1        4.        The method of claim 1 wherein the amount of heat being generated is a function  
2        of an amount of power being consumed by the data center.
- 1        5.        The method of claim 4 wherein each of the plurality of cooling resources has a  
2        cooling capability wherein the cooling capability is a function of an amount of heat that  
3        can be removed by the cooling resource and the act of activating each of a plurality of  
4        different cooling resources in an optimal fashion further comprises:  
5                activating each of a plurality of different cooling resources based on the amount  
6        of heat that can be removed by each of the plurality of cooling resources.
- 1        6.        The method of claim 1 wherein the plurality of cooling resources comprises an  
2        air-based cooling resource, a liquid-based cooling resource and a gas-based cooling  
3        resource.
- 1        7.        The method of claim 6 wherein the act of activating each of a plurality of

2 different cooling resources within the data center in an optimal fashion further  
3 comprises:  
4       activating the air-based cooling resource before the liquid-based cooling resource  
5 and the gas-based cooling resource; and  
6       activating the liquid-based cooling resource before the gas-based cooling  
7 resource.

1 8. A system for dynamically controlling cooling resources in a data center  
2 comprising:  
3       means for determining a workload within the data center;  
4       means for determining an amount of heat being generated as a function of the  
5 workload; and  
6       means for activating each of a plurality of different types of cooling resources  
7 coupled within the data center in an optimal fashion based on the amount of heat being  
8 generated.

1 9. The system of claim 8 wherein the method further comprises:  
2       means for deactivating one or more of the activated plurality of different types of  
3 cooling resources within the data center based on a reduction in the amount of heat being  
4 generated.

1 10. The system of claim 8 wherein the amount of heat being generated is a function  
2 of an amount of power being consumed by the data center.

1 11. The system of claim 10 wherein each of the plurality of cooling resources has a  
2 cooling capability wherein the cooling capability is a function of an amount of heat that  
3 can be removed by the cooling resource and the means for activating each of a plurality  
4 of different cooling resources in an optimal fashion further comprises:  
5       means for activating each of a plurality of different cooling resources based on  
6 the amount of heat that can be removed by each of the plurality of cooling resources.

1 12. The system of claim 11 wherein the plurality of cooling resources comprises an

2 air-based cooling resource, a liquid-based cooling resource and a gas-based cooling  
3 resource.

1 13. The system of claim 12 wherein the means for activating each of a plurality of  
2 different cooling resources within the data center in an optimal fashion further  
3 comprises:

4 means for activating the air based cooling resource before the liquid based  
5 cooling resource and the gas based cooling resource; and

6 means for activating the liquid based cooling resource before the gas based  
7 cooling resource.

1 14. A data center comprising:

2 a global computer system;

3 a plurality of different cooling resources coupled to the global computer system;

4 and

5 a cooling resource control module coupled to the global computer system and the  
6 plurality of different cooling resources wherein the cooling resource control module  
7 includes logic for:

8 determining a workload within the global computer system;

9 determining an amount of heat being generated as a function of the  
10 workload; and

11 activating each of a plurality of different types of cooling resources  
12 coupled to the global computer system in an optimal fashion based on the amount of heat  
13 being generated .

1 15. The data center of claim 14 wherein the optimal fashion is based on a cost  
2 associated with the activation of each of the plurality of different cooling resources.

1 16. The data center of claim 14 wherein cooling resource control module further  
2 comprises logic for:

3 deactivating one or more of the activated plurality of different types of cooling  
4 resources within the data center based on a reduction in the amount of heat being

5 generated.

1 17. The data center of claim 14 wherein an amount of heat being dissipated by the  
2 global computer system is a function of an amount of power being consumed by the  
3 global computer system.

1 18. The data center of claim 17 wherein each of the plurality of cooling resources has  
2 a cooling capability wherein the cooling capability is a function of an amount of heat that  
3 can be removed by the cooling resource and the logic for activating each of a plurality of  
4 different cooling resources in an optimal fashion further comprises logic for:

5 activating each of a plurality of different cooling resources based on the amount  
6 of heat that can be removed by each of the plurality of cooling resources.

1 19. The data center of claim 14 wherein the plurality of cooling resources comprises  
2 an air-based cooling resource, a liquid-based cooling resource and a gas-based cooling  
3 resource.

1 20. The data center of claim 19 wherein the logic for activating each of a plurality of  
2 different cooling resources coupled to the global computer system in an optimal fashion  
3 further comprises logic for:

4 activating the air based cooling resource before the liquid based cooling resource  
5 and the gas based cooling resource; and

6 activating the liquid based cooling resource before the gas based cooling  
7 resource.

1 21. A computer program product for dynamically controlling cooling resources in a  
2 global computer system, the computer program product comprising a computer usable  
3 medium having computer readable program means for causing a computer to perform the  
4 steps of:

5 determining a workload within the global computer system;

6 determining an amount of heat being generated as a function of the workload; and

7 activating each of a plurality of different types of cooling resources coupled to the

8 global computer system in an optimal fashion based on the amount of heat being generated.

1 22. The computer program product of claim 21 wherein the optimal fashion is based  
2 on a cost associated with the activation of each of the plurality of different cooling  
3 resources.

1 23. The computer program product of claim 21 further comprising means for causing  
2 a computer to perform the step of:  
3 deactivating one or more of the activated plurality of different types of cooling  
4 resources within the data center based on a reduction in the amount of heat being  
5 generated.

1 24. The computer program product of claim 21 wherein the plurality of cooling  
2 resources comprises an air-based cooling resource, a liquid-based cooling resource and a  
3 gas-based cooling resource.

1 25. The computer program product of claim 19 wherein the step of activating each of  
2 a plurality of different cooling resources coupled to the global computer system in an  
3 optimal fashion further comprises:  
4 activating the air-based cooling resource before the liquid-based cooling resource  
5 and the gas-based cooling resource; and  
6 activating the liquid-based cooling resource before the gas-based cooling  
7 resource.

1 26. A cooling resource control module for a data center comprising:  
2 determination logic for:  
3 determining a workload within the data center; and  
4 determining an amount of heat being generated as a function of the  
5 workload; and  
6 activation logic for activating each of a plurality of different types of cooling  
7 resources within the data center in an optimal fashion based on the amount of heat being  
8 generated.

1       27.     The cooling resource control module of claim 26 further comprising logic for:  
2             deactivating one or more of the activated plurality of different types of cooling  
3 resources within the data center based on a reduction in the amount of heat being  
4 generated.

1       28.     The cooling resource control module of claim 26 wherein the plurality of  
2 different types of cooling resources comprise an air-based cooling resource, a liquid-  
3 based cooling resource and a gas-based cooling resource.

1       29.     The cooling resource control module of claim 28 wherein the logic for activating  
2 each of a plurality of different types of cooling resources within the data center in an  
3 optimal fashion further comprises logic for:  
4             activating the air-based cooling resource before the liquid-based cooling resource  
5 and the gas-based cooling resource; and  
6             activating the liquid-based cooling resource before the gas-based cooling  
7 resource.